REMARKS

Claims 1, 2, 4-14, and 20-31 are pending in the Application. Claims 29 and 31 have been cancelled. Reconsideration and allowance of the Application in light of the following remarks are respectfully requested.

Claim Amendments

In response to Applicants' previous arguments, the Examiner has asserted that certain properties recited in claim 12 are inherent in the materials recited in that claim. With respect to claims 28 and 30, the Examiner has asserted that the limitations of those claims are inherent in the process shown in the Nakamura et al. ('422) reference on which the Examiner has been relying, and with respect to claim 27, the Examiner has asserted that the composition of the atmosphere in which the device is processed (recited in the claim) is a processing limitation and therefore carries no weight in a claim drawn to a devise.

As emphasized below, heat-treating the device in an oxygen-containing atmosphere is important to obtaining the claim-recited product. Although the Examiner has made his assertions as to the composition of the atmosphere in which the device is processed not being entitled to patentable weight in the context of dependent claim 27, Applicants have amended independent claim 12 (from which the rest of the pending claims depend) to refer to that methodological consideration in the past tense to clarify that what is being claimed is the product that has resulted from such methodological considerations. Because the methodological considerations do, in fact, bear on the product obtained, Applicants respectfully submit that the nature of the atmosphere in which the device is treated carries patentable weight and therefore is entitled to consideration.

New Matter Objection

The amendment filed May 29, 2001 is objected to under 35 U.S.C. § 132 for allegedly introducing new matter into the disclosure of the invention, the examiner's position and reliance on that section of the statute (instead of 35 U.S.C. § 112) presumably being predicated on the claims themselves also constituting disclosure. Claims 29 and 31 have been cancelled. Therefore, the Objection under § 132 is moot.

Claim Rejections – 35 USC § 102

Claims 12-14, 21, 27, 28, and 30 are rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by Nakamura *et al.* ('422). With respect to claims 12-14, the Examiner contends that Nakamura *et al.* ('422) shows a group III compound semiconductor device with p-type upper or surface layer 13 and an electrode consisting of a layer of Ni with a layer of Au on top. The Examiner further contends that the device has a contact layer 15 and a bonding pad 17 that covers part of layer 15, with the bonding pad having a protective film of silicon oxide. The Examiner dismisses other features recited in the claims as inherent in the materials and/or simply ignores further limitations in the claims. Applicants respectfully traverse this rejection for at least the following reasons.

The light-emitting semiconductor device recited in independent claim 12 includes a surface layer of p-type semiconductor, a first electrode layer and a second electrode layer on top of the surface layer, and an electrode pad on top of and partially covering the second electrode layer. By specifically heat-treating the device in an atmosphere containing oxygen, the portion of the material of the second electrode layer which is not covered by the electrode pad is caused to pass into and to be distributed more deeply into the p-type semiconductor surface layer than the material of the first electrode layer is distributed into the p-type semiconductor surface layer as explained, for example, at page 6 of the Preliminary Amendment filed on May 29, 2001. As a result, contact resistance that exists between the p-type semiconductor surface layer and the portion of the electrode layer that is not covered by the electrode pad is lower than contact resistance that exists between the p-type semiconductor surface layer and the portion of the electrode layer that is covered with the electrode pad. Consequently, an area of comparatively high contact resistance exists between the first electrode layer and the surface layer of the p-type semiconductor immediately under the electrode pad. As a result, electric current across the device is blocked by the high contact resistance area and diverted laterally so that the region under the electrode pad does not needlessly emit light, emission of which would be blocked by the electrode pad. Thus, the luminous efficiency of the device is improved.

Although Nakamura *et al.* '422 apparently discloses an electrode consisting of Ni with Au on top, Nakamura *et al.* does not heat treat the device in an atmosphere containing oxygen such that the portion of the material of the second electrode layer which is not covered by the electrode pad will have been caused to be distributed more deeply into the p-

type semiconductor surface layer than the material of the first electrode layer will have been caused to be distributed into the p-type semiconductor layer. In Nakamura *et al.*, the device is annealed under different conditions. Indeed, Nakamura *et al.* states at col. 5, lines 64-67 and col. 6, lines 1-8 that "the metallic material layer tends not to establish a good ohmic contact with the p-layer 13, when annealed at a temperature below 400°C . . . [such that] it is preferred that the annealing treatment be conducted under a non-oxidative or inert atmosphere." Therefore, in contrast to the present invention (where the heat treatment has been performed in an atmosphere containing oxygen in order to yield the device recited in claim 12), Nakamura *et al.* anneals the device under inert conditions, i.e. in the absence of oxygen. Applicants submit that since the device of Nakamura *et al.* is annealed in the absence of oxygen, Nakamura *et al.* would not obtain the device recited in claim 12 (i.e., a device in which the material of the second layer that is not covered by the electrode pad has been caused to be distributed more deeply into the surface layer than that of the first electrode layer and in which, as a result, a current-blocking high contact resistance area exits under the electrode pad). Accordingly, Applicants respectfully submit that claim 12, and therefore claims 13, 14, 21, 27, 28, and 30 which depend directly or indirectly from claim 12, is patentable. Applicants therefore respectfully request that the rejection of claims 12-14, 21, 27, 28, and 30 under § 102(e) be withdrawn.

Claim Rejections – 35 USC § 103

Claims 1, 2, 4-11, 20, and 22-26 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Nakamura *et al.* ('422) in view of Manabe *et al.* and Nakamura *et al.* ('350). The Examiner contends that Nakamura *et al.* ('422) shows a group III compound semiconductor device with a p-type upper layer 13 and an electrode consisting of a layer of Ni with a layer of Au on top. The Examiner further contends that the device has a contact layer 15 and a bonding pad 17 that covers part of the contact layer 15, with the bonding pad having a protective film of silicon oxide. The Examiner contends that Nakamura *et al.* ('422) also shows that the bonding pad 17 is composed of Ni and Au. The Examiner concedes that Nakamura *et al.* ('422) specifically teaches against the use of Al (which is recited in the claims as constituting a top layer in the electrode pad) since it can migrate to the electrode and degrade it (col. 7, lines 23-25 in Nakamura *et al.*). However, the Examiner notes that Manabe *et al.* shows an intermediate layer of aluminum in a multilayer electrode stack and

therefore contends that it would have been obvious to modify the Nakamura *et al.* ('422) device to include the Al layer of Manabe *et al.*, with the expectation that intervening layers between the aluminum layer and the electrode layer will protect the electrode from deterioration. Applicants respectfully traverse this rejection for at least the following reasons.

First, Applicants reiterate the arguments filed on December 19, 2001. Specifically, Applicants reiterate that the proposed combination of Nakamura *et al.* and Manabe *et al.* is contrary to the express teachings of Nakamura *et al.* Nakamura *et al.* teaches away from using aluminum in the electrodes and pads because of the resulting degradation of the luminous transmitivity. Nakamura *et al.* explicitly instructs that the electrode pad 17 is preferably formed of gold alone, or a metallic material containing at least two metals including gold, but that the electrode pad should not contain aluminum or chromium (see, col. 7, lines 10-15).

In addition, Nakamura *et al.* explains that gold, titanium, nickel, indium, and/or platinum exhibit good adhesion with the p-electrode 13 and exhibit good adhesion with a metallic ball formed from a bonding wire during wire bonding (see, col. 7, lines 13-18 in Nakamura *et al.*). In the claimed invention, in contrast, aluminum is used for the third layer on top of the second gold layer because the protective film adheres to aluminum better than it adheres to gold (see, for example, page 3 of the specification). In other words, the invention can be viewed as "giving up" or foregoing some of the benefit that would be obtained in terms of wire bonding for the benefit that is obtained in terms of having the protective film adhere to the electrode pad. Because Nakamura *et al.* explicitly teaches that gold should be used because it has better adhesive properties with the wire bonding metallic ball, one having skill in the art would not have been motivated to replace that gold layer of the electrode pad with aluminum. Furthermore, Nakamura *et al.* lists alternate materials that can be used in the electrode pad, and that list includes nickel, which also exhibit good adhesion with the metallic ball. Manabe *et al.* also teaches that nickel can be used as the top layer in the electrode pad. Therefore, if, for the sake of argument, one were to combine Manabe *et al.* with Nakamura *et al.*, Applicants submit that nickel would be used on top of the gold layer in Nakamura *et al.*, not aluminum, because as noted above, Nakamura *et al.* teaches that nickel exhibits good adhesion with the metallic ball.

Consequently, neither Nakamura *et al.* ('422) nor Manabe *et al.*, taken alone or in combination, discloses, teaches, or suggests the subject matter recited in claim 1.

Claim 22 depends from claim 12. Therefore, Applicants submit that claim 22 is patentable for at least the foregoing reasons. Moreover, neither Nakamura *et al.* ('422) nor Manabe *et al.*, discloses, teaches, or suggests, alone or in combination, that the third metal layer comprises a material to which the protective film adheres better than the protective film adheres to gold. Indeed, the top layer in the electrode pad of Nakamura *et al.* is preferably gold (see, col. 5, lines 50-53), as explained above. The top layer in the electrode pad of Manabe *et al.* is nickel, and Manabe *et al.* is completely silent as to providing a protective film and hence as to adhesion between such a film and the electrode pad layers.

Therefore, Applicants respectfully submit that claims 1 and 22, and therefore claims 2, 4-11, 20, and 23-26 which depend directly or indirectly from either claim 1 or claim 22, are patentable and respectfully request that the rejection of claims 1, 2, 4-11, 20, and 22-36 under § 103(a) be withdrawn.

CONCLUSION

In view of the foregoing, Applicants submit that the claims are now in form for allowance, and such action is hereby solicited. If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, he is kindly requested to contact the undersigned at the telephone number listed below.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached Appendix is captioned **"Version with markings to show changes made"**.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,

Pillsbury Winthrop LLP

By: _____

Kenneth M. Fagin
Reg. No.: 37,615
Tel. No.: (703) 905-2066
Fax No.: (703) 905-2500

KMF/KG
1600 Tysons Boulevard
McLean, VA 22102
(703) 905-2000

Enclosure: Appendix

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Claims 29 and 31 have been cancelled herein without prejudice or disclaimer.

Claim 12 has been amended as follows:

12. (Four Times Amended) A light-emitting semiconductor device having a Group III nitride compound semiconductor comprising:

a surface layer made of p-type semiconductor;

a multi-layered electrode layer comprising a first electrode layer formed on said surface layer and a second electrode layer formed on said first electrode layer;

an electrode pad covering a portion of said second electrode layer and leaving another portion of said second electrode layer uncovered; and

wherein said first electrode layer comprises a material which has an ionization potential lower than that of said second electrode layer, said second electrode layer comprises a material which has an ohmic characteristic to said semiconductor better than that of said first electrode layer, and the portion of said material of said second electrode layer which is uncovered by said electrode pad [is] has been caused to be distributed more deeply into said surface layer than that of said first electrode layer by heat treatment in atmosphere comprising oxygen [and] to provide[s] a contact resistance between said electrode layer and said surface layer lower than said portion covered with said electrode pad, and a high contact resistance area [is] that has been formed between said first electrode layer and said surface layer of said p-type semiconductor right under said pad, whereby electric current in downward direction is blocked at said high contact resistance area and flows to a lateral direction.

END OF APPENDIX